

Materials Tip



Materials Engineering Branch

High Friction and Wear Rate of Graphite in Vacuum			
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For terrestrial applications, graphite is frequently used for sliding electrical contacts, motor brushes, and lubrication because of its low friction, low wear rate, and high electrical conductivity. Graphite has a laminar planar hexagonal crystal structure with very anisotropic properties. Water and other contaminants are absorbed between the laminar crystallographic layers to allow the layers to slide over themselves easily. The absorbed water produces the low friction and the low wear rate in air that makes graphite an excellent lubricant (see Ref. 1 and 2).

When graphite is exposed to vacuum, the absorbed interlaminar water and other contaminants evaporate or outgas from the graphite. In vacuum, the coefficient of friction increases by a factor of about 500 percent and the wear rate increases very rapidly. When motor brushes with high graphite content were used in a space application, the high friction often stalled the motors or the high wear rates abraded and shorted the commutators. When graphite is inadvertently used as a lubricant in high vacuum, the five-fold increase in the coefficient of friction always causes failure. Graphite sliding electrical contacts, motor brushes, and lubricants should not be used for space applications.

References:

1. Surface Effects in Adhesion, Friction, Wear, and Lubrication by Donald H. Buckley, 1981, Elsevier North-Holland Inc., 52 Vanderbilt Avenue, New York, NY 10017, pp. 573
2. Graphite Lubrication by Robert H. Savage, Journal of Applied Physics, Volume 19, No. 1, January, 1948, pp. 1